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MOLDED SYNTHETIC RESIN SHEET

CLAIM(S)

1) A molded synthetic resin sheet characterized in that at least its one surface as pyramid-shaped convexities or concavities with a 1 - 10 mm height or depth and with a 30 mm or lesser bottom diameter or diagonal at 3 - 30 mm pitch, and in that at least one surface has micro convexities and concavities, wherein the mean roughness in the center line is 2.5 μm or more and there are 5 or more concavities with 0.5 μm or larger per 1 mm length.

DETAILED DESCRIPTION OF THE INVENTION

(Field of Industrial Application)

The present invention pertains to a molded synthetic resin sheet for use in light fixture cover.

(Prior Art)

A transparent resins, such as a methacrylic resin and polystyrene resin, are extensively used for a light fixture cover after molded into a sheet form. For a functional characteristics of a light fixture cover, the following two characteristics are very important:

1) A characteristic of high energy efficiency as well as an overall light ray transmittance.

2) A characteristic that the light source does not hit an eye directly through the cover, and that a soft illumination has an excellent glare-shielding effect to protect human eyes.

In the prior art well-known method for providing such characteristics, pyramid shaped convexities or concavities are continuously made in the surface of a resin sheet.

(Problems of the Prior Art to Be Addressed)

With a cylindrical fluorescent lamp most well-known as a light source of a light fixture, however, the entire body of the light source is not visible, but each convexity or concavity in the molded surface is divided into a bright section and dark section. The partial image of the light source is visible in the bright section, making it glare to an naked eye and undercutting a glare shielding effect.

There is a well-known mat synthetic resin sheet, on which micro convexities and concavities are mechanically made in the surface. However, when said fluorescent lamp is viewed through this mat sheet, the entire light source is seen through. So it is necessary to shield the light by adding, for example, barium sulfate but, with this method, an overall light transmittance declines reducing an energy efficiency.

The present invention, to solve the aforementioned problems, attempts to

present a molded synthetic resin having a sufficient glare-shielding effect and a high energy efficiency.

(Means to Solve the Problems and Operation)

The molded synthetic resin sheet structure of the present invention is characterized in that pyramid-shaped convexities or concavities having the height or depth 1 - 10 mm and bottom diameter or diagonal length 30 mm or less are made at 3 -30 mm pitch at least on one surface of the synthetic resin sheet. Also, separately from them, micro 5 μm or larger convexities and concavities having center line mean roughness 2.5 μm or more are made at least on one surface of the molded synthetic resin sheet by 5 units per 1 mm length.

More specifically, the molded synthetic resin sheet of the present invention has the molded surface with pyramid-shaped convexities and concavities (Hereinafter referred to as molded surface) and a mat surface on which micro convexities and concavities are formed (Hereinafter referred to as mat surface). Each one of these surface processes may be done to each of the surfaces, or both processes may be done to one of the surfaces (Hereinafter, the surface with both processes is referred to as "mat molded surface"), the surface with no process at all as "planar surface," and the surface with either process as "molded planar surface," or "mat planar surface.").

The present invention is explained in detail below.

Types of the synthetic resin used for the synthetic resin mold sheet is not

limited to a specific type but, to meet the primary goal of making a light fixture cover, they have to be a transparent synthetic resin, such as a methacrylic resin, polystyrene resin, polycarbonate resin, or vinylchloride resin. In the present invention, an ultraviolet ray absorbing agent, a fluorescent agent, a thermal stabilization agent, and a coloring agent may be added by a tiny amount.

In the present invention, the convexities and concavities on the molded surface are in pyramid shape, and their height (of convexities) or depth (of concavities) is 1 - 10 mm. The pyramid shape is a triangular pyramid, square pyramid or cone. In case of polygonal pyramid, its diagonal is 30 mm or less, and in case of cone, its diameter is 30 mm or less. When the bottom is in triangular shape, its one lateral determines the size and when the bottom is in oval shape, its longer diameter determines the size. In the present invention, the pyramid-shaped convexities and concavities are preferably arranged with regularity; they can be arranged in sequence, or each convexity or concavity is alternately offset not to create any planar portion on the molded surface. Particularly, it is preferred that the triangular, square, or hexagonal pyramids are continuously formed without any planar portion at all. The pitch of these convexities and concavities is 3 - 30 mm, and the pitch refers to the distance between the apexes of the adjacent pyramids in convex or concave form.

The shape of the micro convexities and concavities has mean roughness 2.5 μm or more in the center line, and 5 or more concavities with 0.5 μm or more per 1

mm length are needed.

The mean roughness and the number of concavities with 0.5 μm or more are defined by the following measuring method.

1) Mean roughness in the center line: the mean roughness in the center line stipulated by JIS-B-0601 is measured by a contact needle type surface roughness measuring device in pursuant to JIS-B-651.

2) Number of concavities with 0.5 μm or more: by using the contact needle type surface roughness measuring device pursuant to JIS-B-0601, the number of concavities per the standard length is sought and is converted to the number per 1 mm by presetting the count level to less than 0.5 μm from the centerline and counting every other points at which the count level and the curved line of the roughness cross with each other as one concavity.

When the molded synthetic resin sheet is used as a light fixture cover, the entire image of the fluorescent lamp as the light source is not visible due to presence of convexities and concavities on the molded surface. Also, a partial image of the light source is not visible since the light from the light source is diffused by the micro convexities and concavities on the mat surface when the light from the light source comes in and out, creating an excellent glare-shielding effect for naked eye. When the height of the convexity or the depth of concavity is less than 1 mm or more than 10 mm, when the pitch is less than 3 mm or more than 30 mm, or when the length of said bottom diameter or of diagonal is more than 30 mm, the entire image of the

fluorescent lamp as the light source becomes visible. Also, when the mean roughness in the center line in the surface roughness of the mat surface is less than 2.5 μm or when the number of concavities with 0.5 μm or more is less than 5 per 1 mm length, the light diffusion is reduced and the partial image of the light source is visible, so the light glares to naked eye by an insufficient glare shielding effect.

A specific example of the molded synthetic resin sheet of the present invention is shown in Fig. 1 (a) - (e). In the present invention, the molded planar surface or mat planar surface can be processed only to one of the surfaces. Therefore, depending upon the types of manufacturing process, resin, and of expected shielding effect, any of the following can be selected out of the following 5 types: each of said processes is done to each different surface (a); both processes were done to one of the surfaces (b); a molded surface is formed on one surface while forming the mat surface on both surfaces (c); the molded surface is formed on both surfaces while forming the mat surface on one surface (d); both the molded surface and the mat planar surface are formed on both surfaces (e).

In the present invention, the thickness of the molded sheet is not specifically limited to a specific thickness, but a light fixture cover is generally about 1 - 10 mm. Therefore, the molded synthetic resin of the present invention is preferably 30 mm in the thickest section and 1 mm or more in the thinnest section. With the sheet which is too thick, its weight will be too heavy, creating an excessive burden on the light fixture and increasing the cost of the resin, but with the sheet which is too thin,

the strength is insufficient.

The manufacturing method for the molded synthetic resin sheet of the present invention is not limited but, for example, the extrusion molding shown in Fig. 2 can be cited. For the rolls 25-No. 1 - 25''-No. 3 shown in Fig. 2, the planar roll (f), molded roll (g), and mat roll (h) are used, respectively. The resin extruded from the die is brought into contact with these rolls and cooled for solidification. By so doing, the protrusions are transferred to one surface of the resin sheet, and the micro convexities and concavities are transferred to the opposite surface to form the molded sheet of Fig. 1 (a). Changing the shape of the roll surface forms the molded sheet having the surfaces of Fig. 1 (b) - (e) and molded surfaces with different shapes and mat surfaces.

When the molded sheet is manufactured by extrusion molding using 3 rolls, a method, whereby a material prepared mixing an inorganic additive, such as a talc powder, white carbon powder, and a glass powder, in a methacrylic resin in a Henshell mixer, may be used.

(Embodiment)

(Embodiment Example 1)

By using a melted methacrylic resin ("Derubetto 70" made by Asahi Chemical Engineering, Inc.) was extruded into a sheet form by a 90 ϕ vent type single screw extrusion machine and a 1,000 wide mm T-type die, and a 3mm thick molded sheet was formed by using 3 rolls shown in Fig. 2.

As for the rolls used, a planar roll was used for roll No. 1. For roll No.2, was used a mat surface-molding roll that can create the mat surface continuously having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 44 mm of pitch, the surface roughness with 5 μm mean roughness in the center line, and 7 units of 0.5 μm or larger concavities per 1 mm length. For roll No. 3, was used mat roll that can provide the same mat surface as that created by No. 2. Thus, the molded sheet having the mat molded surface on one surface and the mat planar surface on the opposing surface was formed.

The molded sheet was tested for its total light ray transmittance by an integrated spherical light transmittance measuring device. Also, the visibility of the light source (i.e., glare-shielding effect) was measured by a naked eye using the method and device shown in Fig. 3. The micro convexities and concavities on the mat surface and the number of concavities were measured by said needle contact type surface roughness meter. The result is shown in Table 1.

(Embodiment Example 2)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the mat surface-molding roll that can create the mat surface having mat surface continuously having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 4 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 14 units of 0.5 μm or larger concavities per 1 mm length. The molded sheet was measured.

The result is shown in Table 1.

(Embodiment Example 3)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the mat surface-molding roll that can create the mat surface continuously having square pyramid-shaped concavities with a 8 mm depth and a 25 mm square bottom at 25 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 7 units of 0.5 μm or larger concavities per 1 mm length. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 4)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 3 was replaced with the planar surface roll. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 5)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 3 was replaced with the molding roll continuously having 4 mm square pyramid-shaped concavities with a 4 mm square bottom and a 4 mm depth at 4 mm pitch. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 6)

The molded sheet was formed by the same method as that in embodiment

example 1 except that roll No. 3 was replaced with a mat surface-molding roll that can create the mat surface continuously having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 4 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 7 units of 0.5 μm or larger concavities per 1 mm length. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 7)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the molding roll continuously having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 4 mm pitch, and roll No. 3 was replaced with the mat surface-molding roll that can create the mat surface having the mat surface continuously having square pyramid-shaped concavities with a 4 mm depth and a 4 mm square bottom at 4 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 7 concavities with 0.5 μm or larger per 1 mm length. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 8)

The material of the molded sheet was prepared by mixing 2 parts/weight of white carbon powder (water-containing amorphous silica, SiO_2, nH_2O) in 100 parts/weight of methacrylic resin ("Derubetto 70H" by Asahi Chemical Engineering, Inc.) in Henshell mixer. The molded sheet was formed from this material by the

same method as that in embodiment example 1 except that roll No. 2 was replaced with the molding roll continuously having square concavities with a 4 mm depth and a 4 mm square bottom at 4 mm pitch, and that roll No. 3 was replaced with a planar roll. The molded sheet was measured. The result is shown in Table 1.

(Embodiment Example 9)

The molded sheet was formed by the same method as that in embodiment example 1 except that a polystyrene resin ("Styrone 666" made by Asahi Chemical Engineering, Inc.) was used as the material. The result is shown in Table 1.

(Embodiment Example 10)

The material of the molded sheet was prepared by mixing 2 parts/weight of white carbon powder (water-containing amorphous silica, SiO_2, nH_2O) in 100 parts/weight of polystyrene resin ("Styrone 666" made by Asahi Chemical Engineering, Inc.) in Henshell mixer. The molded sheet was formed from this material by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the molding roll continuously having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 4 mm pitch, and that roll No. 3 was replaced with the planar surface roll. The molded sheet was measured. The result is shown in Table 1.

(Comparative Example 1)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the molding roll continuously

having square pyramid-shaped concavities with a 2 mm depth and a 4 mm square bottom at 4 mm pitch, and that roll No. 3 was replaced with the planar surface roll. The molded sheet was measured. The result is shown in Table 1.

(Comparative Example 2)

The molded sheet was formed by the same method as that in embodiment example 1 except that No. 2 and No. 3 rolls were replaced with the molding roll continuously having square pyramid-shaped concavities with a 2 mm depth and with a 4 mm square bottom at 4 mm pitch. The molded sheet was measured. The result is shown in Table 1.

(Comparative Example 3)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the mat surface-molding roll that can create the mat surface continuously having square pyramid-shaped concavities with a 2 mm depth and with a 4 mm square bottom at 4 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 4 concavities with 0.5 μm or greater per 1 mm length. The molded sheet was measured. The result is shown in Table 1.

(Comparative Example 4)

The molded sheet was formed by the same method as that in embodiment example 1 except that roll No. 2 was replaced with the planar surface roll, and that roll No. 3 was replaced with the mat surface-molding roll that can create the mat

surface continuously having square pyramid-shaped concavities with a 2 mm depth and a with a 40 mm square bottom at 40 mm pitch, the surface roughness with 5 μm mean roughness in the center line, and 7 concavities with 0.5 μm or greater per 1 mm length.

The molded sheet was measured. The result is shown in Table 1.

(Comparative Example 5)

The material of the molded sheet was prepared by mixing 3 parts/weight of barium sulfate in 100 parts/weight of methacrylic resin ("Derubetto 70 H" by Asahi Chemical Engineering, Inc.) in Henshell mixer. This material was molded into the mold sheet by the same method as that in comparative example 1 except that the material was changed. The molded sheet was measured. The result is shown in Table 1.

Blank space

Table 1

Note for the table

O: Not visible

X: visible

Embodiment example and comparative example	resin (100 parts/ wight)	additive (part/ weight)	surface shapes	back surface shape	space between micro concavity and convexity (μ)	total light transmittance (%)	visibility of the whole body of light source	visibility partial body of light source
Embodiment example 1	methacrylic resin	none	mat planar surface	mat molded surface	150	90	O	O
Embodiment example 2	methacrylic resin	none	mat planar surface	mat molded surface	70	90	O	O
Embodiment example 3	methacrylic resin	none	mat planar surface	mat molded surface	250	90	O	O
Embodiment example 4	methacrylic resin	none	planar surface	mat molded surface	150	90	O	O
Embodiment example 5	methacrylic resin	none	mat planar surface	planar molded surface	150	90	O	O
Embodiment example 6	methacrylic resin	none	mat molded surface	mat molded surface	150	90	O	O
Embodiment example 7	methacrylic resin	none	mat molded surface	planar molded surface	150	90	O	O
Embodiment example 8	methacrylic resin	white carbon 2	mat planar surface	mat molded surface	70	88	O	O
Embodiment example 9	polystyrene resin	none	mat planar surface	mat molded surface	150	87	O	O
Embodiment example 10	polystyrene resin	white carbon 2	mat planar surface	mat molded surface	70	88	O	O
Comparative example 1	methacrylic resin	none	planar surface	planar molded surface	none	90	O	X
Comparative example 2	methacrylic resin	none	planar molded surface	planar molded surface	none	90	O	X

Comparative example 3	methacrylic resin	none	mat planar surface	mat molded surface	30	90	X	O
Comparative example 4	methacrylic resin	barium sulfate 2	planar surface	planar molded surface	none	40	O	O

(Advantage)

As is explained above, the molded synthetic resin sheet of the present invention has a high light transmittance and an excellent glare-shielding effect. Therefore, when it is used for a light fixture cover, the whole body or partial body of its light source is not visible to a naked eye, providing it with a soft feel, which is good to human health.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the molded synthetic resin sheet of the present invention in varying appearances. Fig. 2 shows a schematic diagram of the molded synthetic resin sheet in the manufacturing process of the present invention. Fig. 3 shows the rolls used for manufacturing. Fig. 4 shows a graph indicating the measuring method and device for measuring the visibility of the light source.

1. Mat planar surface

2. Planar molded surface

3. Planar surface

4. Mat molded surface

21. Material

22. Extrusion machine

23. T-shaped die

24. Melted resin in sheet form

25, 25', 25''. Rolls

26. Receiving roll

27. Molded sheet